**OPTION #1**

Ms. Smith wants to build a new rectangular courtyard on the blacktop. It will be laid out using square tiles. She has chosen some very pretty but inexpensive tiles. However, she wants some of the tiles to light up a la *Billie Jean*, and those tiles will be more expensive. The light-up tiles will always be on the diagonal, from one corner of the courtyard to the opposite corner. Every tile that contains a segment of the diagonal must be a light-up tile.

For example, the diagram at right shows what the situation would look like if Ms. Smith made a 4 x 6 courtyard. In this case, eight tiles form some portion of the diagonal, and so these would need to be light-up tiles. Ms. Smith wants to know how many of these special tiles she needs to order. She is planning to have a 63-by-90 courtyard.

She might change her mind about the size of the courtyard, so it would be helpful to know a general formula that would work with any size courtyard. That is, suppose the courtyard has ***r*** rows and ***c*** tiles in each row. How many light-up tiles would she need?



Here’s a number pattern: **OPTION #2**

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16 17 18 19 20 21

11 12 13 14 15

7 8 9 10

4 5 6

2 3

1

Your job:

* Draw out the next 3 rows of the pattern.
* Describe, in as many ways as possible, how this pattern changes. Be sure to discuss the different structures to this pattern.
* Figure out which number is directly above 100.
* Figure out a way to determine what number is directly above any given number.

**OPTION #3**:

The goal of this POW is to use only the number 3 four times to create arithmetic expressions with different numerical values according to the rules for order of operations.

EXAMPLES: NON-EXAMPLES:

33 – 3 + 3 3 + 3 + 3 x 3 x 3

33 + 33 3 + 3 x 2 – 1

33 x 3 – 3 3 x 3 + 3 – 3 + 3 + 3

33 / 3 – 3 4 + 0 – 1 x 2 + 3

Remember: the number 3 must appear EXACTLY four times in each expression.

Rules (aside from what’s written above):

* You may use addition, subtraction, multiplication, and division (but following the order of operations).
* You may use exponents.
* You may use square roots. (And you may use different operations underneath the square root, too.)
* You may use a factorial, where you take a number and multiply it by every number before it. It looks like this: 3! – and it means: 3! = 3 x 2 x 1
* You may put 3s together: 33 or 333, for example.
* You may use parentheses and brackets. For example: (3 + 3) x 3 – 3 or [(3 x 3) – 3]3.
* You may include negative numbers.
* You can use any combination of operations listed here in each expression.

**Your job: You must write threes expressions that equal the numbers from 1 to 30.**

Special notes for the write-up:

The same write up applies (problem statement, process, solution, extensions, self-assessment), but there are some special notes for 3 sections…

* **Special process notes**: As always, your process part must include these things, but there is special emphasis for this particular POW…
  + EVERY PIECE OF SCRAP WORK AND EVERY EXPRESSION YOU EVER WROTE AS YOU WORKED ON THIS must be included.
  + Every thought you had as worked must be included.
  + A detailed account of your strategies/strategy must be included. How did you figure out eh
  + If you asked people for help, you must say who they are, describe the help you got, and explain how the help helped you.
  + If you worked with other people, you must say who they are and describe what you did together.
* **Special solution notes**: You must write out each expression you got WITH the correct work shown out. (that follows the order of operations) There is no extra explanation required—just show the work that proves that your expression is correct.